Neutron Measurements for Radiation Protection in Low Earth Orbit – History and Future

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The neutron environment inside spacecraft has been of interest from a scientific and radiation protection perspective since early in the history of manned spaceflight. With the exception of a few missions which carried plutonium-fueled radioisotope thermoelectric generators, all of the neutrons inside the spacecraft are secondary radiations resulting from interactions of high-energy charged particles with nuclei in the Earth's atmosphere, spacecraft structural materials, and the astronaut's own bodies. Although of great interest, definitive measurements of the spacecraft neutron field have been difficult due to the wide particle energy range and the limited available volume and power for traditional techniques involving Bonner spheres. A multitude of measurements, however, have been made of the neutron environment inside spacecraft. The majority of measurements were made using passive techniques including metal activation foils, fission foils, nuclear photoemulsions, plastic track detectors, and thermoluminescent detectors. Active measurements have utilized proton recoil spectrometers (stilbene), Bonner Spheres (^{3}He proportional counter based), and LiI(Eu)-phoswich scintillation detectors. For the International Space Station (ISS), only the plastic track/ thermoluminescent detectors are used with any regularity. A monitoring program utilizing a set of active Bonner spheres was carried out in the ISS Lab module from March – December 2001. These measurements provide a very limited look at the crew neutron exposure, both in time coverage and neutron energy coverage. A review of the currently published data from past flights will be made and compared with the more recent results from the ISS. Future measurement efforts using currently available techniques and those in development will be also discussed.